



Advanced Materials

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Advanced Industrial Gas Turbine Systems

The purpose of this research is to advance the state of development of one or more advanced materials systems for integration into Advanced Industrial Gas Turbine Systems used in power generation service.

In order to reach this goal, development, subsystem testing, and demonstration of optimized and fully integrated components using advanced materials systems must be performed. The fully developed, demonstrated advanced material(s) and turbine system(s) would accomplish the following objectives:



Objectives

1. Improve the performance of Advanced Industrial Gas Turbines through the use of advanced materials systems. Potential benefits include:
 - a) decreased energy consumption and emissions,
 - b) increased process efficiencies,
 - c) enhanced U.S. industrial competitiveness, and
 - d) decreased reliance on strategic materials (raw or engineered materials for which the U.S. is fully or near fully dependant on foreign sources for supply). Other projected benefits include increased operating time before maintenance and overhaul, utilization of waste fuels, etc.



Objectives

(continued)

2. Identify promising advanced material systems, optimize processing techniques and foster maturation of a competitive, cost effective manufacture of these system(s) in commercial quantities.
3. Position or adapt the technology for transition from natural gas to back-up fuels as well as alternative biomass-derived fuels, while achieving a substantial reduction in Oxides of Nitrogen (NO_x) emissions for these fuels, and decrease in energy consumption.



Objectives

(continued)

4. Demonstrate that the durability of the proposed component(s) of advanced materials is at least as durable as the present day component it is to replace.
5. Improve the performance of a variety of gas turbine characteristics including efficiency, fuel flexibility, cost of power, and reliability and maintainability.



Objectives

(continued)

6. Encourage adoption and use of energy-efficient cost-effective gas turbines.
7. Capitalize on the considerable supporting information on materials already available from prior Government-sponsored research.



Cost Sharing

- Applicants are required to cost share the following minimum percentages of the total costs to be incurred performing the respective task(s) to be eligible for award under this solicitation.
 - Task 1 or Task 2 30 percent
 - Task 3 or Task 4 45 percent
 - Task 5 60 percent
 - Subtask A and Subtask B *
- * The cost share requirement for Subtask A and Subtask B shall be at the level of cost share required for the lowest task number proposed. In addition, all costs associated with Subtasks A and/or B shall be reflected in the budget information provided for the task(s) which the subtask is a part.



Advanced Materials

- GE Global Research and Development
- Teledyne Continental Motors
- Siemens Westinghouse
- Solar Turbines

DOE Funding is \$7.0 Million over 3 years



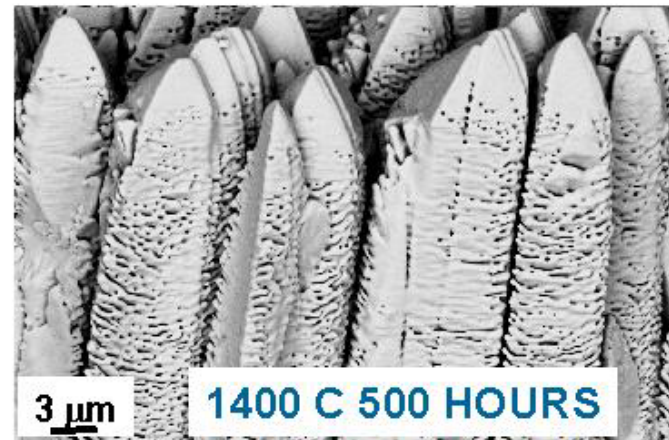
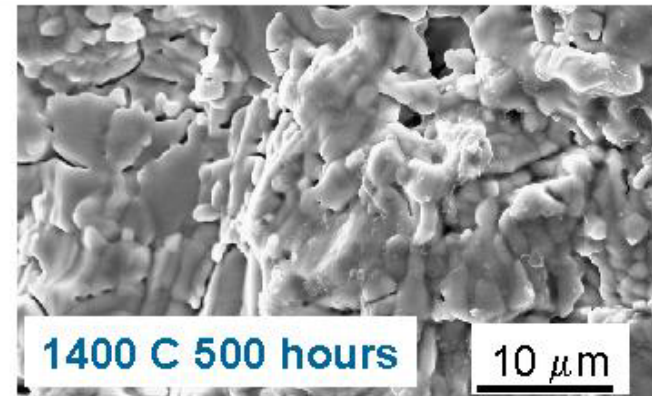
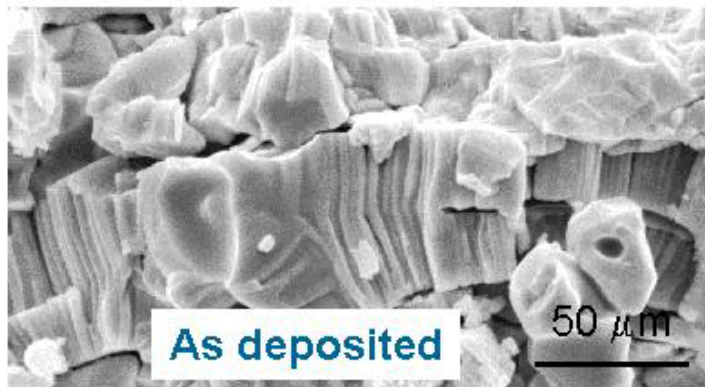
Siemens Westinghouse Advanced Materials Project



- Cooperative Research and Development for Advanced Materials in Advanced Industrial Gas Turbines, Siemens Westinghouse Power Corporation.
- Partners: Turbine Airfoil and Coatings Repair (TACR, formerly Chromalloy Turbine Technologies); Howmet Corporation; COI Ceramics/Lo-Tec; Westinghouse Plasma Corporation; Transtech; Praxair Surface Technologies; Oak Ridge National Laboratory; Applied Thin Films, Inc.
- Siemens Westinghouse will advance the development of thermal barrier coatings and demonstrate in a field test at a host site.



N32 ceramic compositions, more sinter resistant and phase stable than 8YSZ, are successfully deposited by APS and EB-PVD





W501 FC blades and vanes have been successfully coated with new TBCs



- Thickness and microstructure met product specification requirements.
- Consistent composition across airfoil and platform.



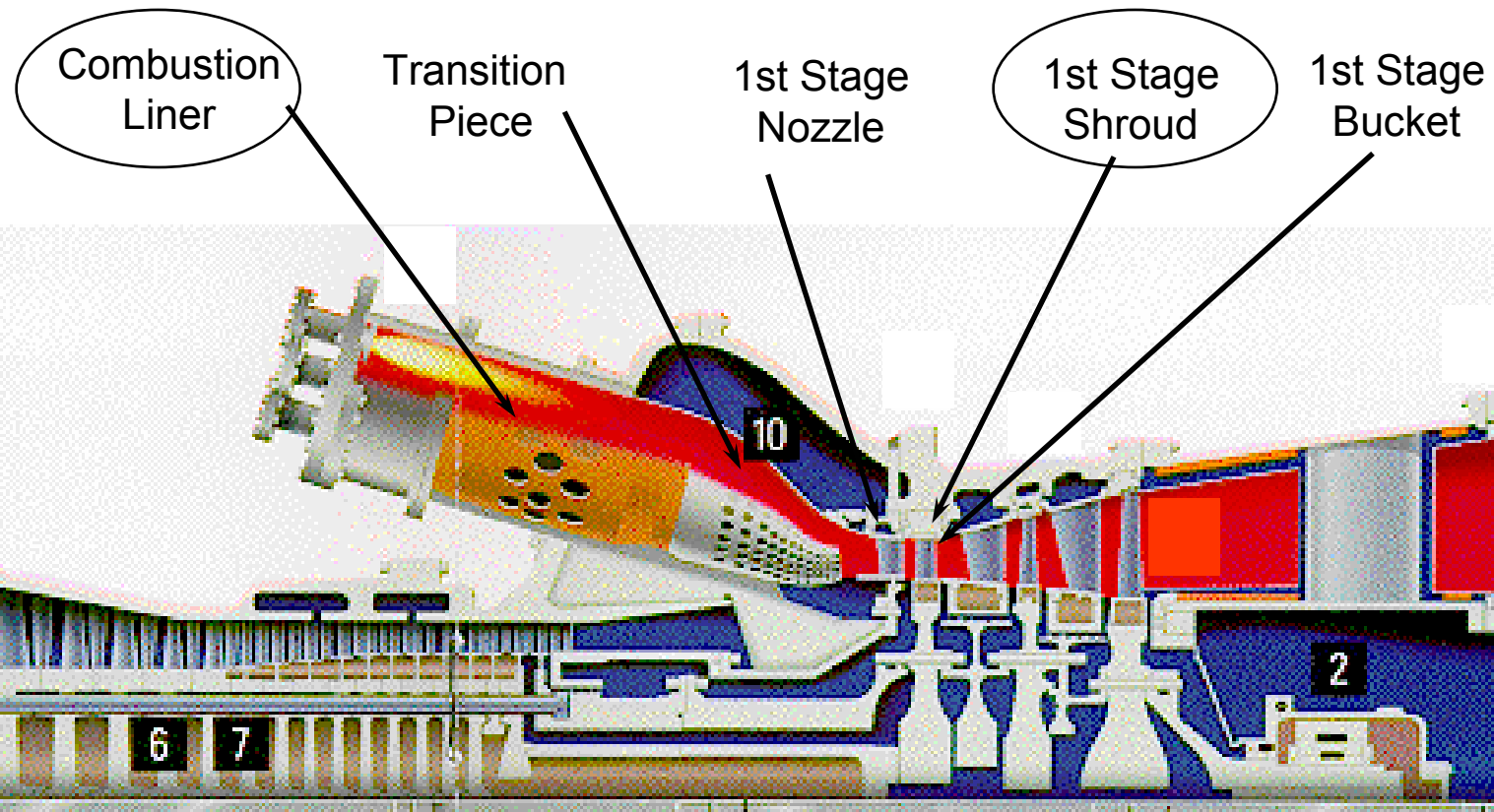
GE Advanced Materials

- Melt Infiltrated Ceramic Matrix Composites for Shrouds and Combustor Liners of Advanced Industrial Gas Turbines – General Electric Global Research Center, (\$2.7 million)
- Partners: G>E> Power Systems; Honeywell Advanced Composites (now GE Power System Composites); B.F. Goodrich Aerospace; and Oak Ridge National Laboratory
- GE will focus on application of MI composites to first stage shrouds of industrial gas turbines, followed by combustor liners, building upon efforts under the Continuous Fiber Ceramic Composite (CFCC) program. The technology will subsequently be applied to other hot stage stationary components, including the combustor transition piece & nozzles.



Applications

GE Industrial Gas Turbine Engine



- ***Stationary components represent the best short-term opportunity***



Solar Turbines Advanced Materials

- **Advanced Materials for Mercury 50 Gas Turbine Combustion System**, Solar Turbines (\$3.1 million)
- Honeywell Advanced Composites; Goodrich Corporation; Schwarzkoph Technologies Corporation; The Welding Institute; Praxair Surface Technologies; Univ. of Connecticut; Oak Ridge National Laboratory; Pratt Whitney – United Technologies Research Center; Argonne National Laboratory; Honeywell Ceramic Components; and Clemson University
- Demonstrate a fully-integrated Mercury 50 combustion system, modified with advanced materials technologies, at a host site for 4,000 hours.
- Continue field testing of Ceramic components at Chevron / Texaco and Malden Mills, initiated under CSGT Program.



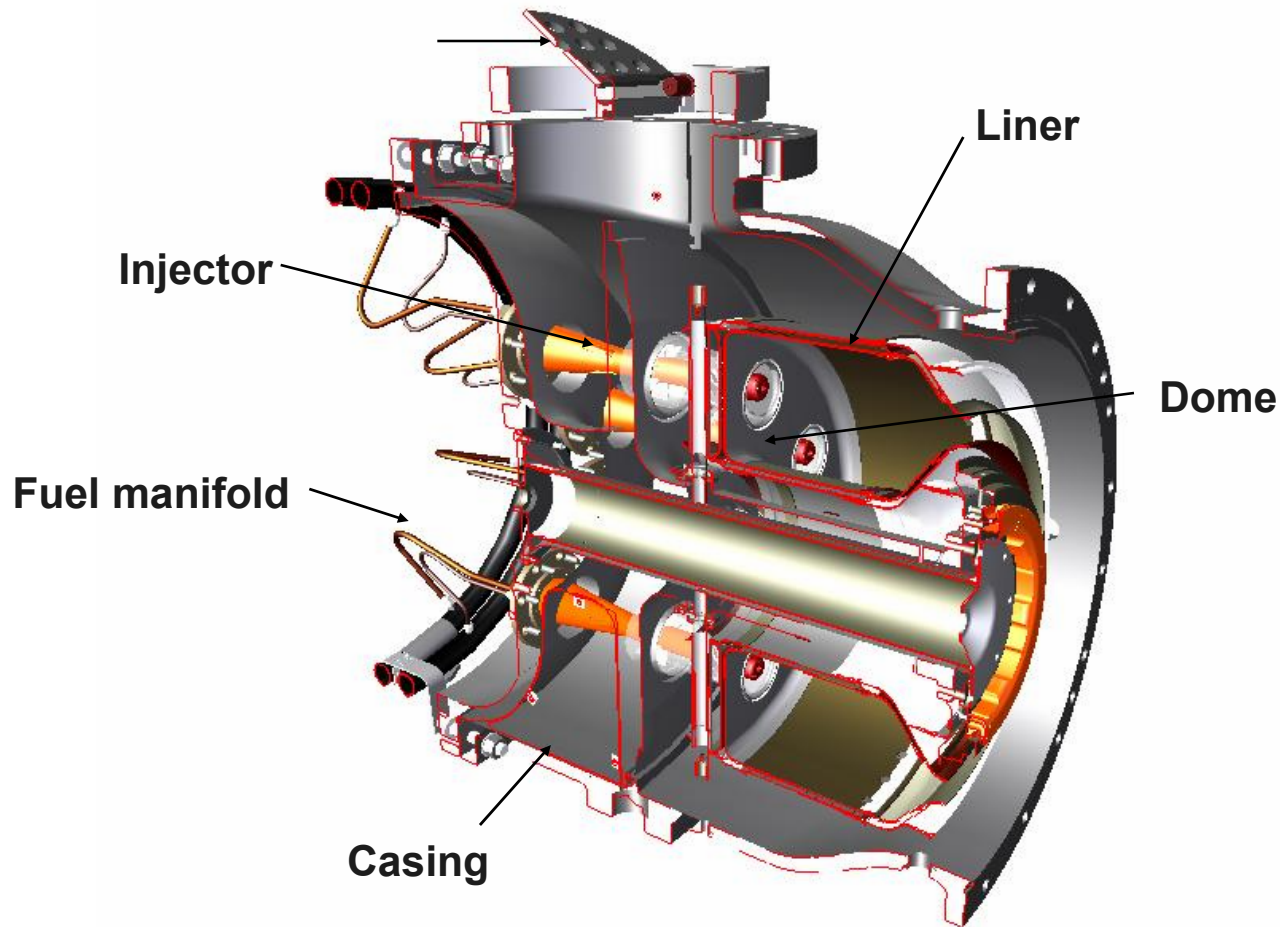
Solar Turbines Advanced Materials

- Advanced Materials for Mercury 50 Gas Turbine Combustion System (\$3.1 million)
 - Demonstrate a fully-integrated Mercury 50 combustion system, modified with advanced materials technologies, at a host site for 4,000 hours.
 - Continue field testing of ceramic components at Chevron/Texaco and Malden Mills, initiated under the CSGT Program.



Advanced Industrial Gas Turbine System

M50 Combustion Module





Teledyne Advanced Materials

- Advanced Materials in Advanced Industrial Gas Turbines – Teledyne Continental Motors (\$300,000)
- Partners: Titanium Products; 3 – ONE – 2; and Consolidated Technologies
- Apply advanced material systems to microturbine components to enable a 450°F cycle temperature increase from first generation design to obtain improvement in the thermal efficiency performance by over a factor of 120%.
 - Low cost process for pressure consolidation of powder nickel super-alloys.
 - Flexible pattern mold process to be used for powder consolidation for net shape processing,
 - Titanium silicon carbide (Ti_3SiC_2) for stationary turbine stage components.